MOBILITY TRANSFORMATION CENTER
UNIVERSITY OF MICHIGAN

July 5, 2016

The Honorable Tom Wheeler
Chairman
Federal Communications Commission
445 12th Street, S.W.
Washington, DC 20554

Dear Chairman Wheeler:

On behalf of the University of Michigan Mobility Transformation Center (MTC), I am writing in response to proceeding FCC 16-68 and ET Docket No. 13-49, in which the Federal Communications Commission seeks comments about potentially sharing Unlicensed National Information Infrastructure (U-NII) devices and Direct Short Range Communications (DSRC) operations in the 5GHz Band.

MTC understands that the FCC intends to undertake 5.9GHz spectrum testing under a three-phase plan that includes lab tests at FCC, vehicle field tests through the U.S. Department of Transportation, and large-scale “real-world” tests. The MTC and its members strongly support this approach and believe it can generate comprehensive results that will enable objective and science-based decisions.

MTC and its members offer to make our facilities available for the real-world testing phase. We have a significant number of vehicles, plus real-world test environments, that could be used. Specifically, MTC is working with its members and other partners, including the U-M Transportation Research Institute (UMTRI), to deploy the world’s largest and most concentrated DSRC vehicle fleet on the streets of Ann Arbor. In addition, MTC last year opened Mcity, a facility for testing connected and automated vehicles and technologies in a safe, controlled environment before trying them out in real traffic.

This letter consists of three parts: (i) an overview of MTC activities; (ii) MTC current and future use cases for DSRC channels and applications; and (iii) more information about our offer to help with the FCC’s planned real-world testing.

<u>Overview of MTC activities</u>

MTC is a public-private partnership among industry, government and academia, led by U-M. A key goal of MTC is to deploy a shared network of connected and automated (including driverless) vehicles in Ann Arbor by 2021. Currently, MTC has 62 members from a wide range of industries: automotive OEMs and tier-one suppliers, telecommunications, insurance, semiconductors, traffic equipment manufacturers, and consumer electronics. The complete list of MTC members can be found in Appendix I.

MTC, working with its members and other partners, is developing three connected and automated vehicle deployments, known as Living Laboratories. (i) **Living Lab 1**: MTC is building on the connected vehicle deployment launched in 2012 by UMTRI and U.S. DOT to deploy 9,000 connected vehicles operating throughout a connected infrastructure of 60 roadside-units in Ann Arbor, focusing on vehicle-to-vehicle (V2V) and vehicle-to-pedestrian (V2P) applications. When our target of 9,000 DSRC vehicles in Living Lab 1 is reached in 2018, it will represent 10 percent of the Ann Arbor vehicle population, by far the highest concentration of vehicles in a DSRC test environment in the world. (ii) **Living Lab 2**: MTC is partnering with its industry members and the Michigan Department of Transportation to deploy up to 20,000 connected vehicles in Southeast Michigan, focusing on vehicle-to-infrastructure (V2I) applications. (iii) **Living Lab 3**: The third MTC living lab is the planned connected and autonomous vehicle service in Ann Arbor.

Another asset operated by MTC is Mcity, a test facility with 18 acres of roadways and infrastructure expressly designed for connected and automated vehicle testing. Mcity simulates a broad range of complexities vehicles encounter in urban and suburban environments. It includes approximately five lane-miles of roads with intersections, traffic signs and signals, sidewalks, benches, simulated buildings, streetlights, and obstacles such as construction barriers. More than 10 MTC members have already used Mcity and the Ann Arbor living laboratory environment to develop and test connected and automated vehicle applications.

MTC current and future use cases for DSRC channels and applications

With the support of U.S. DOT, U-M in 2012 equipped 2,800 vehicles with DSRC and GPS antennae and radios, and installed 25 roadside units (RSUs). Extensive research, testing, and field trials of safety applications using Channels 172 and 178 was conducted. Channels 174, 176, 180, 182, and 184 were used for alternate service channels. Four message types were deployed using Channel 172: Basic Safety Message (V2V), MAP Message (V2I), Signal Phase and Timing Message (V2I) and Traveler Information Message (V2I). About 300 of the 2,800 vehicles were equipped with Aftermarket Safety Devices and used the DSRC messages for Curve Speed Warning (CSW), Forward Collision Warning (FCW), and Emergency Electronic Brake-light (EEBL). Additionally, 64 vehicles were deployed with several V2V safety applications, including CSW, FCW and EEBL, plus Intersection Movement Assist (IMA), Blind Spot Warning (BSW), Lane Change Warning (LCW), Do Not Pass Warning (DNPW), and Left Turn Assist (LTA). Lastly, three transit vehicles were deployed with Right Turn in Front Warning and Pedestrian Detection, in addition to CSW, FCW and EEBL.

While 2,800 DSRC vehicles may suggest an extensive deployment, it represents only 3 percent of the motor vehicle population in Ann Arbor. Analysis of the data collected at intersections confirms that at any time there were usually no more than seven vehicles within the DSRC communication range surrounding any RSU. Therefore, channel utilization is rather low compared with theoretical capacity (6Mb/sec). However, with the expansion of deployment to 9,000 DSRC vehicles and added V2P applications, future DSRC traffic is likely to be much higher. Therefore, we have defined a future channel use plan that starts to use other channels. MTC has placed an order for 1,000 new on-board units from Delphi Automotive, with delivery expected around October of this year. These initial OBUs will have two radios to enable message transmission on four DSRC channels (172, 178, 180 and 182). Channel 172 will implement a continuously operating radio dedicated solely to V2V messages. A second radio will switch between the control channel 178, and two service channels, 180 and 182. By the end of 2016, MTC expects to order retrofit OBUs that will use six channels for the Living Lab 2 vehicle fleet.

The applications that have been deployed, or are planned for future deployment, in MTC's three living labs are summarized in Appendix II. Additionally, future applications, such as connected and automated vehicle driving features, cooperative adaptive cruise control, and truck platooning, that might need dedicated communication channels to exchange large message sets to ensure safe driving. These functions are in the early research phase, and are being pursued not only by MTC, but also through ITS research in Japan, projects funded by the European Union, and by U.S.-based companies such as Peloton Technology. Cooperative autonomous driving functions have the potential to bring significant fuel savings or mobility benefits. Many freight companies monitor the development carefully because the new technology can mitigate a shortage of professional truck drivers, and improve operational flexibility by using robot drivers. MTC strongly urges FCC to take these future applications into consideration while making a decision on 5GHz spectrum sharing.

Comments about MTC's offer to help with FCC testing

With moderate effort, we can gather several hundred DSRC-equipped vehicles at Mcity to conduct tests that reflect congested urban traffic conditions. As the map in Appendix III shows, Mcity includes both highway and urban sections. The effect of unlicensed Wi-Fi devices, high-power devices and "detect and avoid" devices under heavy traffic conditions can be tested at Mcity, in conditions perhaps as close to real-world as is possible anywhere in the United States. As of now, none of these devices are available to MTC. We are hoping that the FCC will obtain these prototype devices and make them available for MTC testing.

MTC members strongly believe that testing and analysis must be completed to fully understand the effects of DSRC spectrum sharing, and to explore questions such as:

- What detailed mechanisms are needed for any proposed sharing between Wi-Fi and DSRC in the U-NII-4 band?
- Is there interference with DSRC channels when Wi-Fi is introduced in the U-NII-4 band?
- Do adjacent channel interference issues emerge when DSRC and Wi-Fi are used simultaneously in adjacent channels in the U-NII-4 band?

MTC member companies have background and expertise in both the Wi-Fi-telecommunication and automotive-transportation industries. A special "spectrum task force" has been formed within MTC that includes 15 of MTC's 17 Leadership Circle companies. The main charge of the task force is to produce facts and data to support this critical decision about spectrum sharing. MTC looks forward to working with the FCC, U.S. DOT and the National Telecommunications and Information Administration (NTIA) to define a thorough and detailed plan, and to execute real-world (Phase III) testing at Mcity and in Ann Arbor.

Sincerely,

Huei Peng
Director

Enclosures (3)

Appendix I: MTC members

MTC's Leadership Circle of selected industry partners join together with government and U-M faculty to serve as thought leaders in guiding and synthesizing the center's work. The members of the Leadership Circle are:

- BMW
- Delphi Automotive PLC
- DENSO Corporation
- Econolite Group, Inc.
- Ford Motor Company
- General Motors Company
- Honda Motor Co., Ltd
- Intel
- LG Electronics, Inc.
- Navistar, Inc.
- Nissan Motor Co., Ltd
- Qualcomm Technologies, Inc.
- Robert Bosch LLC
- State Farm Mutual Automobile Insurance Company
- Toyota Motor Corporation
- Verizon Communications, Inc.
- Xerox Corporation

Companies can also join as Affiliate Members, and be invited to participate in select MTC activities. Below is the current list of Affiliates:

- 3M
- Allstate Insurance Company
- AGC Automotive
- Arada Systems, Inc.
- Auto Club Enterprises, an AAA affiliate
- Autoliv Electronics
- Brandmotion LLC
- Calspan Corporation
- Changan Automobile
- Cohda Wireless
- Desjardins General Insurance Group, Inc.
- DURA Automotive Systems
- Faurecia
- FedEx Corporation
- Guangzhou Automobile Group, Co., LTD
- Harada Industry of America, Inc.
- Harman International Industries
- HERE

- Hitachi, Ltd.
- IAV Automotive Engineering
- IDIADA
- Iteris, Inc.
- Magna International Inc.
- Mechanical Simulation Corporation
- Miller, Canfield, Paddock and Stone, PLC
- MOBIS
- Munich Re
- New Eagle Consulting, LLC
- Nexteer Automotive
- NXP Semiconductors
- OSIsoft, LLC
- Panasonic Automotive Systems Company
- PTC, Inc.
- Realtime Technologies, Inc.
- Renesas Electronics America Inc.
- Savari Inc.
- SF Motors, Inc.
- Shell Oil Company
- Subaru
- Sumitomo Electric Industries, Ltd.
- Suncorp Group
- TASS International, Inc.
- TRW Automotive
- WSP l Parsons Brinckerhoff
- ZipCar, Inc.

Appendix II: MTC Planned DSRC applications

The DSRC applications already implemented at MTC are listed in the first four rows of the table below and highlighted in yellow. The rest of the table lists DSRC functions identified for possible implementation in MTC's three living laboratories. The messages and applications that, arguably, may not require 10Hz communication are marked with an 'x' in the third column. Connected autonomous vehicle applications may require communications more frequent than 10Hz, and may need a channel dedicated for their usage. The DSRC channels shown in the fourth column are only tentative and may change. However they represent our current plan, which was defined after discussion with MTC industry members.

Applications	Message	Not time critical?	DSRC Channel
Curve Speed Warning	Traveler Information Message (TIM) (Geodetic (MAP) and Weather Info)	x	178,180
Forward Crash Warning	Basic Safety Message (BSM)		172
Electronic Emergency Brake Light	Basic Safety Message (BSM)		172
Signal Phase And Timing	Signal Phase And Timing Message (SPAT)		178,184
Vehicle to Bicycle	Personal Safety Message (PSM)		176
Emergency Vehicle Approach Alert	Emergency Vehicle Alert (EVA)		184
Red Light Violation Warning	Intersection Collision Avoidance (ICA), V2v BSM, V2P PSM, I2V TIM		172,176,184
Pedestrian in Crosswalk	Personal Safety Message (PSM) and SPaT		176,178,184
Vehicle to Pedestrian safety	Personal Safety Message (PSM) and/or TIM		176,178
Event Traffic Management	Traveler Information Message (TIM)		180
Eco Approach	Signal Phase And Timing Message (SPAT) and MAP		178,184
Transit Signal prioritization	Signal Request Message (SRM), Signal Status Message (SSM)	x	184
I2V in-vehicle signage	Multiple – TIM Map Data (MAP)& Roadside Alert (RSA)		multiple
Fuel station pricing	Traveler Information Message (TIM)	x	182
SCMS Updates and Messaging	SCMS		180
Slow/stopped vehicle ahead	RoadSideAlert (RSA)		172
Truck parking - ranked for trucks	TravelerInformation Message (TIM)	x	180
Workzone/Roadworks notification	RoadSideAlert (RSA)		178,180,184
Border wait time	TravelerInformation Message (TIM)	x	180
Road weather	TravelerInformation Message (TIM)	x	180,182
Connected Autonomous vehicles	To be defined (enhanced BSM)	may need > 10Hz	174 (TBD)

Appendix III: Map of Mcity